Regional Earth System Model for U.S. Northeast Corridor

Complexity, Scales, and the Intersection of Modeling Domains

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Genesis of the Project - The Northeast region (NE) in United States exhibits many of the complex changes taking place - landscapes, energy systems and watersheds (13 States)

- Provides a unique lens to assess options for managing large-scale natural resource systems (Figure 1).

An interdisciplinary research team with expertise in physics, biogeochemistry, energy, engineering, economics, and policy engagement to simultaneously study the phenomena with multi-scale and multi-purpose modeling tools and improve the translation of research findings to the research community, academia, decision makers and public.

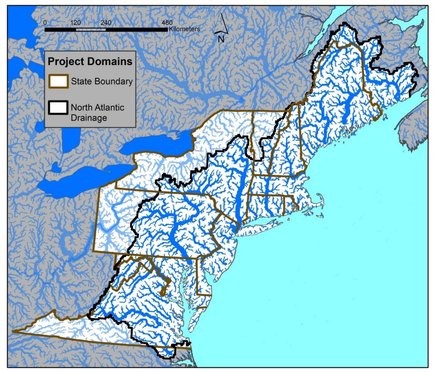

Figure 1: The NE Corridor and its Atlantic watersheds

Intellectual Merit: This project has built a Northeast Regional Earth System Model (NE-RESM) that improves understanding and capacity to forecast the implications of human interactions on the region's environment, ecosystem services, energy, and economy through the 21st century (Figure 2).

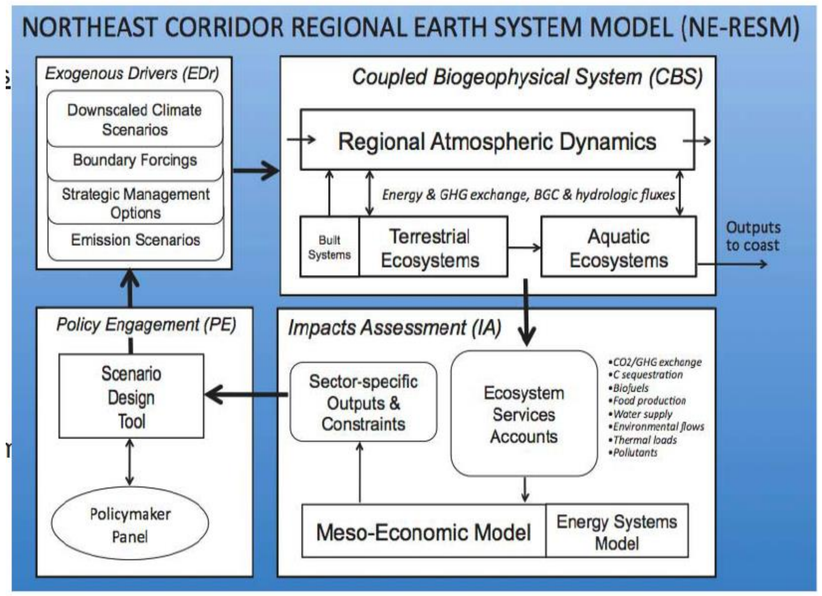

Figure 2: Main elements of the NE-Regional Earth System Model (NE-RESM)

Integration of Complex Systems and Models - We see this research as a major step forward in developing a capacity to diagnose and understand the state of large, complex, interconnected and interacting human-natural systems.

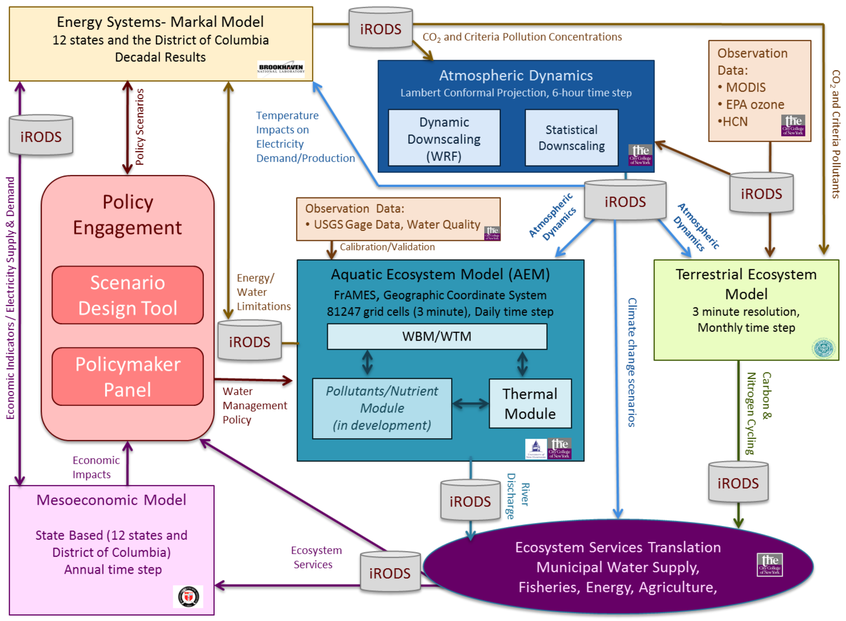

Figure 3: Interconnection of Scientific and Policy Analysis Tools

The unique combination of existing models and data sets enable rapid progress made, emphasizing the integrative and synthetic aspects of our work (Figure 3), with diverse spatial and temporal scales, and process details, requires addressing different scientific questions.

Three strategic Goals, all highly dependent on the region's ecosystem services and nature of climate oscillations and extremes:

- *Energy production capacity in light of water constraints* on hydro and thermoelectric facilities;
- *Biofuels, regional carbon balance and sequestration capacity*, and potential resurgence of agriculture across the region, given national policies and alternative cap-and-trade strategies;
- *Pollution management* to support water quality standards and protect inland aquatic habitat and fisheries.

Energy System Analysis – Brookhaven capabilities allow for the analysis of the complex synergies and feedbacks from impacts of climate change on energy and results of energy use on climate change.

RCP4.5 stabilization scenario (approximately 525 ppm CO2) outlines calibration at the national level and then indicating share of the North-east region with deployment of new and advanced energy production and consumption technologies.

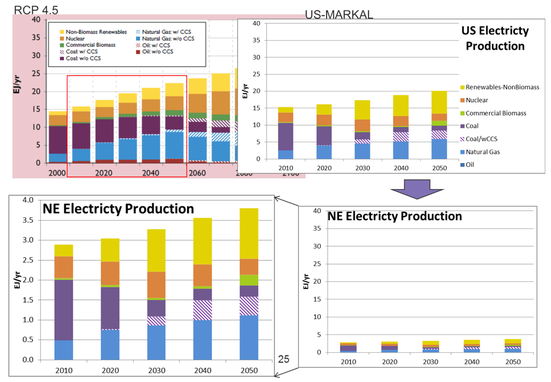

Figure 4. NE-RESM MARKAL Comparison with RCP 4.5 - Electricity Produced

Warmer river water temperature will force some thermal power plants to shut down temporarily, if pollution mechanisms in EPA's Clean Water Act are mandated. This will increase marginal price of electricity.

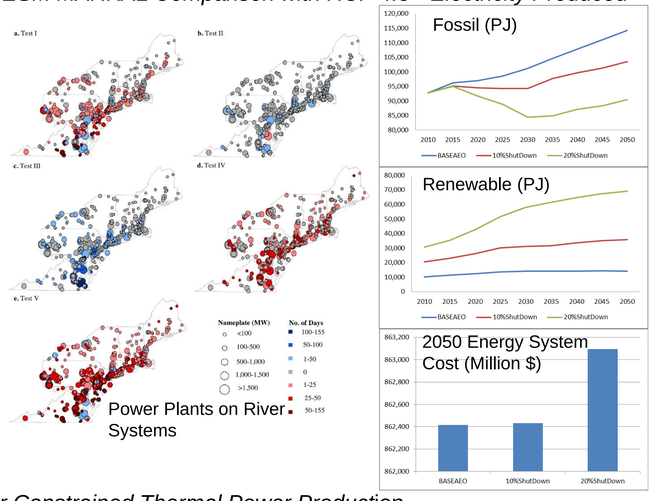

Figure 5: Water Constrained Thermal Power Production

Cooling energy demands are expected to grow as New York City could experience approximately 3 to 4 times more days per year over 90 degrees, approximately 3 to 4 times more heat waves a year – lasting up to 7 days each and more frequent, intense rainstorms.

Figure 6: Warmer Climate Increases Cooling Energy Demands Modeled with New York City MARKAL